

STUDIES OF THE SWEET POTATO WEEVILS OF THE SUBFAMILY CYLADINAE

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It is very interesting to study the relationships which often exist between plants and insects. The sweet potato, *Ipomoea batatas*, and its related wild morning glory species, are attacked in many parts of the world by primitive weevils belonging to the subfamily Cyladinae Kolbe (1897), family Apionidae LeConte (1876), superfamily Attelaboidea Pierce (1916), series Rhynchophora Latreille (1804), order Coleoptera Linnaeus (1758). Only one species of this interesting group has reached North America, and the sweet potato fields of Louisiana, Florida, Texas, and New Mexico, but has not become established in California, due to excellent quarantine, *Cylas formicarius* having been intercepted on a number of occasions in California, and *Cylas turcipennis* having been intercepted in quarantine in sweet potatoes from China, at Vancouver, B. C. The remainder of the genus centers around India, Malaya, Africa and Madagascar, lending some evidences to the previous connection of India with Africa in the Gondwana period of Earth evolution. The only species on which we have any host plant data are all recorded from sweet potato. They breed in the stems and tubers of this food plant and other morning glories.

Most of the studies included in this article were made some years ago, and were based upon specimens in the collections of the United States National Museum, Cambridge Museum of Comparative Anatomy, and the American Museum of Natural History. The microscopic slides upon which studies were made are in the Los Angeles Museum collection.

Reference may be made to an earlier paper by the author on this genus: "Weevils which affect Irish potato, sweet potato, and yam", in Journal of Agricultural Research, 1918, vol. 12, No. 9, pp. 601-612, plates 28-34. In this article are to be found descriptions of *Cylas formicarius* Fabricius, adult; *C. f. elegantulus* (Summers), larva, pupa, adult; *C. turcipennis* Boheman, adult; *C. femoralis* Faust, adult.

The two leading sweet potato weevils, *formicarius* and *turcipennis* are so near alike that the following studies were made to obtain some light on the specific values. The common sweet potato weevil of America has been known for generations as *Cylas formicarius*, but to some extent its spread overlaps that of *C. turcipennis*. Whether we have rightly interpreted Fabricius' original species may never be known positively, but this much is certain, that there is a name positively applicable to the American sweet potato weevil, *Cylas elegantulus* (Summers 1875).

Brentus formicarius Fabricius (1798. Supp. Ent. Syst., p. 174, No. 5) was described as a brownish species from India Oriental.

Cylas turcipennis Boheman (1833. Schönherr's Gen. et Sp. Curc., vol. 1, pp. 369, 370) was described as a greenish species from Java, where it has since been found in sweet potato.

Otidocephalus elegantulus Summers (1875. New Orleans Home Journal and Rural Southland, vol. 10, No. 3, p. 68, January 30; No. 26, December 25) was described as a bluish species from Louisiana, infesting sweet potato. We know, therefore, at least that this name applies to our American sweet potato weevil.

We do not know definitely that the real *formicarius* attacks sweet potato. Its description might fit several species in the genus. But, because of common usage of the name *formicarius* for the sweet potato weevil, and at the same time to be technically correct, it has seemed best to designate this insect as *Cylas formicarius elegantulus* (Summers) Pierce 1918.

I. COMPARATIVE MEASUREMENTS OF THE THREE FORMS

The material assembled consisted of 147 specimens from nineteen countries and states as follows:

CYLAS TURCIPENNIS—elytra green.

Oriental material only. Java, Buitenzorg; Paul Van der Goot, coll.; U. S. Nat. Mus.; 16 specimens. Sumatra, Palembang; W. Knappert, coll.; U. S. N. M.; 2 specimens. Philippines, Bay Laguna Prov.; P. L. Stangl, coll.; U. S. N. M.; 2 specimens.

CYLAS FORMICARIUS ELEGANTULUS—elytra blue

Oriental material:

India or.; Deyrolle coll.; Cambridge Mus. Comp. Anat.; 1 specimen.

Society Islands; A. Garrett, coll., Oct. 1864; C. M. C. A.; 5 specimens.

Madagascar; Deyrolle, Coll.; C. M. C. A.; 5 specimens.

Formosa; Sauter, coll.; American Mus. Nat. Hist.; 1 specimen.

China, Hongkong; Deyrolle, coll.; C. M. C. A.; 1 specimen. F. Maskeu, coll., 1912; U. S. N. M.; 15 specimens.

Hawaii, Oahu; D. L. VanDine, coll.; U. S. N. M.; 6 specimens.

Occidental material:

British Guiana; F. O. Stockdale, coll.; U. S. N. M.; 1 specimen.

Guatemala; D. G. Eisen, coll.; U. S. N. M.; 1 specimen.
Jamaica; U. S. N. M.; 2 specimens. Kingston; J. E. Duerden, coll.; U. S. N. M.; 4 specimens.

Haiti; Sept. 22, 1913; U. S. N. M.; 1 specimen.

Cuba, Havana; C. F. Baker, coll. 5476; U. S. N. M.; 1 specimen. J. H. Esbiro, coll. April 1904; U. S. N. M.; 1 specimen.

Cayamas; E. A. Schwarz, coll. Jan. 2, Feb. 28; U. S. N. M.; 3 specimens.

Guanajay; Palmer and Riley, coll. May 3; U. S. N. M.; 1 specimen.

Puerto Rico, Rio Piedras; T. H. Jones, Coll. Aug. 9, 1912, No. 584-1912; U. S. N. M.; 4 specimens. R. T. Cotton, coll. May 12, 1916; Puerto Rico Exp. Sta.; 2 specimens.

Las Cabezas; Feb. 23, 1916, No. 94-16; P. R. E. S.; 1 specimen.

Mayaguez; A. Busck, Jan. 1899; U. S. N. M.; 1 specimen. R. H. VanZwaluwenberg, coll. Nov. 6, 1917; U. S. N. M.; 5 specimens.

Arecibo; June 24-26, 1915; A. M. N. H.; 1 specimen.

Florida, Key West; Hubbard and Schwarz, coll.; U. S. N. M.; 5 specimens. Manatee; Hubbard and Schwarz, coll.; U. S. N. M.; 2 specimens. Key near Key West; Wickham, coll. June 17-July 1; U. S. N. M.; 1 spec. Lake Worth; F. Blanchard, coll.; C. M. C. A.; 1 specimen. W. H. Ashmead, No. 2387; U. S. N. M.; 9 specimens. W. G. Dietz; C. M. C. A.; 4 specimens.

Louisiana; Dietz, coll. and Blanchard, coll.; C. M. C. A.; 2 specimens. Wickham, coll., Oct. 15; U. S. N. M.; 1 specimen. New Orleans; Hubbard and Schwarz, coll., and Soltau, coll.; U. S. N. M.; 6 specimens. Baton Rouge; Wickham, coll., Sept. 15, 1892; U. S. N. M.; 1 specimen. Centreville; W. J. Young, coll. Oct. 28, 1909; U. S. N. M.; 1 specimen.

Texas; W. G. Dietz, coll.; C. M. C. A.; 1 specimen. Victoria, Sept. 3, 1904; U. S. N. M.; 6 specimens. Brownsville; Jones and Pratt, March 23, 1908; U. S. N. M.; 7 specimens. Wickham, coll. July; U. S. N. M.; 1 specimen. Corpus Christi; F. C. Pratt, coll. Oct. 23, 1905; U. S. N. M.; 2 specimens.

New Mexico, Fort Wingate; October; A. M. N. H.; 2 specimens. Also a few old Riley and Zabriskie specimens without data.

One male specimen from the Deyrolle coll. from India or. has elytra decidedly bluish black, and may be used as our indication of *Cylas formicarius*, although the species was described as brown.

Three male specimens from Buitenzorg, Java, with green elytra may be chosen as typical examples of *Cylas turcipennis*.

Three male specimens from New Orleans, Louisiana, with blue elytra may be chosen as typical examples of *Cylas formicarius elegantulus*.

Measurements of these have been made with a Spencer binocular microscope, eye piece 6x, objective 48, using an eye piece micrometer, with 17 spaces equal to 1 mm. The figures in this and following tables represent the micrometer spaces.

MEASUREMENTS OF SPECIMENS FROM TYPICAL LOCALITIES

Source and Species	Lengths Expressed in Micrometer Spaces (17 spaces = 1 mm.)						Breadths Expressed in Micrometer Spaces		
	Elytra	Thorax	Head	Beak	Club	Funicle	Elytra at Humeri	Thorax at Base	Thorax at Widest Point
India or formicarius	53	22	12	16	20	10	19	11.5	14
Louisiana elegantulus	54	22	13	16	22	11	20	10	15
	55	21	14	17	19	10	19.5	10	15
	56	20	16	17	22	11	20	10	15
Java turcipennis	52	22	13	18	24	10	20	12	14
	54	24	14	18	24	10	21	12	15
	54	23	15	18	26	11	20	11	15

Proportionately the length of the beak is to the length of the head as 1.28:1 in *turcipennis*; 1.33:1 in *formicarius*; 1.14:1 in *elegantulus*.

The length of the club is to the length of the funicle as 2.37:1 in *turcipennis*, 2:1 in *formicarius*, and 1.96:1 in *elegantulus*.

In every measurement made there has developed a great range of variations, and the proportions of any two series of measurements are likewise variable. The tables presented are of great interest in showing specific variation in cosmopolitan insects, an opportunity very rarely afforded us. They also show conclusively how the individual specimens of the two species range in the same limits of measurement for any given character. Comparison of measurements is of little value in this genus.

1. MEASUREMENTS OF LENGTH OF ELYTRA IN MICROMETER SPACES ($17 = 1$ mm.)

COUNTRY	MALES			FEMALES		
	Specimens	Range	Average	Specimens	Range	Average
<i>Cylas turcipennis</i> —						
Java.....	3	52-54	53.3	16	51-54	52.1
Sumatra.....	2	45-49	47.0	..	..	..
Philippines.....	2	50	50.0	..	..	..
	7	45-54	50.5	16	51-54	52.1
<i>Cylas formicarius elegantulus</i> —						
Cuba.....	3	46-51	49.3	5	48-53	50.0
British Solomons....	3	48-52	49.6	..	..	..
Haiti.....	..	..	..	1	50	50.0
Madagascar.....	6	50-54	50.1	..	..	..
Formosa.....	1	52	52.0	..	..	..
Society Islands.....	4	47-57	52.3	..	..	..
New Mexico.....	2	51-54	52.5	..	..	..
India Or.....	1	53	53.0	..	..	..
Louisiana.....	8	50-56	53.3	4	50-55	53.2
Texas.....	7	50-56	53.5	9	51-58	54.3
Honduras.....	2	54-54	54.0	2	54-54	54.0
Florida.....	15	50-57	54.1	13	48-54	51.8
Puerto Rico.....	8	51-57	54.2	6	54-60	55.3
Hongkong.....	6	53-56	54.6	9	50-59	54.8
British Guiana.....	1	55	55.0	..	..	..
Hawaii.....	1	56	56.0	5	54-60	56.1
Jamaica.....	2	55-57	56.0	4	53-60	55.9
	70	46-57	53.4	58	48-60	52.8

2. MEASUREMENTS OF LENGTH OF PROTHORAX IN MICROMETER SPACES (17 = 1 mm.)

COUNTRY	MALES			FEMALES		
	Specimens	Range	Average	Specimens	Range	Average
<i>Cylas turcipennis</i> —						
Java.....	3	22-24	23.0	16	22-23	22.3
Sumatra.....	2	20-20	20.0	..	..	..
Philippines.....	2	19-21	20.0	..	..	..
	7	19-24	21.2	16	22-23	22.3
<i>Cylas formicarius elegantulus</i> —						
British Solomons...	3	18-20	19.3	..	..	..
Cuba.....	3	18-21	19.6	5	19-23	21.2
Honduras.....	2	20-20	20.0	2	21-22	21.5
New Mexico.....	2	20-20	20.0	..	..	..
Texas.....	7	19-21	20.2	9	21-23	22.2
Florida.....	15	19-22	20.5	13	20-22	21.0
Louisiana.....	8	20-22	20.6	4	20-22	21.0
Formosa.....	1	21	21.0	..	..	..
Society Islands.....	4	19-23	21.0	..	..	..
British Guiana.....	1	21	21.0	..	..	..
Madagascar.....	6	20-24	21.3	..	..	..
Haiti.....	..	..	..	1	22	22.0
Puerto Rico.....	8	20-23	21.5	6	24-25	24.3
Jamaica.....	2	21-23	22.0	4	23-25	24.0
India Or.....	1	22	22.0	..	..	..
Hawaii.....	1	22	22.0	5	23-26	24.4
Hongkong.....	6	22-24	22.6	9	22-25	23.6
	70	18-24	20.8	58	19-26	22.5

3. MEASUREMENTS OF LENGTH OF BEAK IN MICROMETER SPACES (17 = 1 mm.)

COUNTRY	MALES			FEMALES		
	Specimens	Range	Average	Specimens	Range	Average
<i>Cylas turcipennis</i> —						
Java.....	3	18-18	18.0	16	13-17	15.0
Sumatra.....	2	14-15	14.5	..	..	..
Philippines.....	2	16-17	16.5	..	..	..
	7	14-18	16.5	16	13-17	15.0
<i>Cylas formicarius elegantulus</i> —						
New Mexico.....	2	14-16	15.0	..	..	..
British Solomons ..	3	14-16	15.0	..	..	..
Society Islands.....	4	14.5-18	15.9	..	..	..
Texas.....	7	14-17	16.0	9	14-17	16.3
Honduras.....	2	15-17	16.0	2	17-17	17.0
Haiti.....	..	..	..	1	17	17.0
Hawaii.....	1	16	16.0	5	16-19	17.7
India Or.....	1	16	16.0	..	..	..
Florida.....	15	15-17	16.3	13	13-17	16.0
Puerto Rico.....	8	16-18	16.5	6	17-19	18.0
Cuba.....	3	16-17	16.6	5	14-17	15.4
Louisiana.....	7	16-17	16.7	4	16-18	16.7
Jamaica.....	2	17-18	17.5	4	16.5-19	17.7
Hongkong.....	6	17-19	17.8	9	17-20	18.9
Formosa.....	1	18	18.0	..	..	..
Madagascar.....	6	17-19	18.0	..	..	..
British Guiana.....	1	18.5	18.5	..	..	..
	69	14-19	16.5	58	13-20	17.0

4. MEASUREMENTS OF LENGTH OF CLUB IN MICROMETER SPACES (17 = 1 mm.)

COUNTRY	MALES			FEMALES		
	Specimens	Range	Average	Specimens	Range	Average
<i>Cylas turcipennis</i> —						
Java.....	3	24-26	24.6	16	8-10	9.4
Sumatra.....	2	21	21.0	..	..	..
Philippines.....	2	21-22	21.5	..	..	..
	7	21-26	22.7	16	8-10	9.4
<i>Cylas formicarius elegantulus</i> —						
Hawaii.....	1	17	17.0	5	9-10	9.6
Cuba.....	3	17-20	19.0	5	8-9	8.6
Society Islands.....	4	16-22	19.2	..	..	..
Jamaica.....	2	18-21	19.5	4	9-10	9.7
Puerto Rico.....	8	19-21	19.8	6	9-10	9.6
British Guiana.....	1	20	20.0	..	..	..
India Or.....	1	20	20.0	..	..	..
Honduras.....	2	20-21	20.5	2	9-10	9.5
British Solomons...	3	20-22	21.1	..	..	..
Louisiana.....	8	19-22	21.1	4	9-10	9.7
Texas.....	7	20-22	21.1	9	9-10	9.6
Florida.....	15	20-22	21.2	13	8-10	9.2
New Mexico.....	2	21-22	21.5	..	..	..
Hongkong.....	6	20-23	21.6	9	9-10	9.6
Formosa.....	1	22	22.0	..	..	..
Madagascar.....	5	21-22.5	22.3	..	..	..
Haiti.....	..	..	..	1	10	10.0
	69	16-22.5	20.7	58	8-10	9.4

5. MEASUREMENTS OF LENGTH OF FUNICLE IN MICROMETER SPACES (17 = 1 mm.)

COUNTRY	MALES			FEMALES		
	Specimens	Range	Average	Specimens	Range	Average
<i>Cylas turcipennis</i> —						
Java.....	3	10-11	10.3	16	12-14	13.5
Sumatra.....	2	10	10.0	..	..	..
Philippines.....	2	10-11	10.5	..	..	..
	7	10-11	10.2	16	12-14	13.5
<i>Cylas formicarius elegantulus</i> —						
India Or.....	1	10	10.0	..	..	..
New Mexico.....	2	10-11	10.5	..	..	..
Louisiana.....	8	10-11	10.6	4	12-14	13.2
Texas.....	7	10-12	11.0	9	11-18	14.1
British Solomons...	3	11	11.0	..	..	..
Florida.....	15	10-12	11.0	13	12-15	13.2
Puerto Rico.....	8	11,12	11.7	6	13-15	13.8
Society Islands.....	4	10.5-13	11.8	..	..	..
Formosa.....	1	12	12.0	..	..	..
British Guiana.....	1	12	12.0	..	..	..
Honduras.....	2	12	12.0	2	14	14.0
Jamaica.....	2	12	12.0	4	14-15	14.3
Madagascar.....	5	12-13	12.2	..	..	..
Cuba.....	3	12-13	12.3	5	12-14	13.2
Hongkong.....	6	12-14	12.6	9	13-15	14.3
Hawaii.....	1	15	15.0	5	14-15	14.6
Haiti.....	..	..	..	1	14	14.0
	69	10-15	11.4	58	11-18	13.8

II. STUDIES OF THE IMMATURE STAGES

Descriptions of the larva and pupa of *Cylas formicarius elegantulus* were published in the 1918 paper.

At first there seemed possibly a tangible difference in the pupae of *elegantulus* and *turcipennis*, as the description of the pupa of *turcipennis* from the Friendly Islands, by Brown, and the illustrations of Indian specimens by Basu and Dutt, indicated six apical prothoracic tubercles, while certain specimens of *elegantulus* had eight.

I have therefore studied a series of pupae from Barbados, and another series from Texas, and find that normally there are six marginal setigerous tubercles, and two discal, with two tiny setigerous tubercles near the larger discal pair. Twelve Barbados specimens (75%) and 17 Texas specimens (85%) were normal. One Barbados specimen had two setae on each of the front pair

of tubercles. One Texas specimen had two setae on one of the front pair. Three Barbados, and two Texas specimens had four tubercles on one side, and three on the other, together with a pair of large and a pair of tiny discal tubercles. It therefore appears that eight tubercles on the margin is abnormal.

I also examined specimens from Java and found six to be the normal number of tubercles, but one individual had three on the left and four on the right.

The structure of the terminal hooks was also so variable as to be of no taxonomic value.

III. A NOTE ON THE MOUTH PARTS

On dissection of adult specimens it appeared that the male maxilla of *turcipennis* has the palpiger and three-jointed palpus equalling in length the lacinia, even when the palpus is drawn in; while in *elegantulus* with palpus extended, it did not equal in length the lacinia.

IV. STUDIES OF MALE GENITALIA

The first really good characters were found in the genitalia.

1. *Cylas formicarius elegantulus* (Plate 36, figs. 1-9).

Description based on study of nineteen American specimens.

Eighth sternite (fig. 8) transverse, basally strongly emarginate, hence basal angles long; base (v) medianly bilobed; median lines short; apex deeply and broadly emarginate (w), making two strong apical lobes (x) at the outer angles (fig. 2); sides greatly narrowed behind, sinuate.

Ninth sternite, or spicule (figs. 7, 9) stout, forked; the lobes (t) of the fork stout, rounded at apex; cleavage broadly rounded; rod (u) more or less strongly bent at about the middle, slightly hooked at apex. The spicule is too variable in shape to use as a dependable character.

Tenth segment, or ring piece (fig. 6) more or less perpendicular with stout, straight postvinculum composed of two fused struts (1). Tegument membranous (n, o, s), with median chitinous rod or uncus (p), and apical fork (q) of uncus separating and bracing the delicate hairy lobes or socii (s).

The epiphallus, or eleventh tergite (figs. 1, 3, 4, 5) is a pair of slender rods (h) fused from middle posteriorly almost to the genital pore (near i). The verga (i) or tip containing the genital pore is tongue-like and forming a distinct process, hardly visible from above or below, but plain on slide mounts. The anterior struts or epipleurites (f) are enlarged at tip, united to the hypo-

pleurites (g), and apparently continuous with the epiphallus (h). The paramera or hypopleurites (g) are lightly connected to the struts or epipleurites (f), slender at base, broadening below where they join the sternites periphallus (j) and hypophallus (k). These are united at apex to form an ogival process; the edges (j) are turned in to form a sort of protecting trough for the phallus (e) or sac, and the verga (i).

The flagellum and endophallus lie within the sac or ductus ejaculatorius, the anterior or narrow portion of which is the stenazygos (b), and the widened posterior portion, the euryzygos (c). The endophallus consists of two large oval lobes (c) each with a strong apical hook (d) to form the valves of the median foramen. The flagellum (a) is a long and slender rod, with broad, crescentiform base and constriction just beyond base. (Figs. 1, 4).

2. *Cylas turcipennis* (Plate 36, figs. 10, 11).

Described from seven Java specimens.

Eighth sternite transverse (fig. 11), basally strongly emarginate, with long basal angles; medianly slightly angulate; median line longer than in *elegantulus* (fig. 8); apex not so deeply or broadly emarginate, with strong apical lobes; sides greatly narrowed, deeply constricted.

Spicule not so greatly curved, hooked at tip. Lobes of endophallus (fig. 10) each with a short spur.

The two species are very close together, and agree in other points.

3. *Cylas femoralis* Faust (Plate 37, figs. 1-5).

Described from a specimen from Mt. Coffee, Liberia.

Eighth sternite (fig. 5) basally very strongly emarginate, with long basal angles, and without angle or lobe medially; Median line very short; apex deeply and broadly emarginate, with long, narrow lateral lobes; sides greatly narrowed, somewhat broadly constricted opposite base of apical lobes.

Ninth spicule (fig. 4) strongly curved, hooked at tip, with median portion at fork, very thin, giving the impression of very narrow stems to the tines of a fork, which are in reality as broad at base as at apex, but heavily chitinized only on the outsides. That the spicule is a fusion of two struts is apparent by the cleavage line almost to tip.

The postvinculum is almost straight, enlarged at tip. The socii are longer than in *elegantulus* (fig. 1).

The struts of the epiphallus are fused for a very short distance near verga, which is blunt spear-shaped (fig. 2); struts curved at anterior apex (fig. 1). Paramera rather broad.

The lobes of endophallus (fig. 3) are each armed with a long spur, as long as the body of endophallus. Two palpiform rods (fig. 1) are visible in the phallus beyond the endophallus.

Otherwise very similar to *elegantulus*.

V. STUDIES OF FEMALE GENITALIA (Plate 38)

The female abdomen in *Cylas formicarius elegantulus* is composed of five exposed sternites and seven exposed tergites. The seventh tergite is the prepygidium (e7).

The first two sternites are internal, so that the fifth ventral segment is the sternite of the seventh segment. The first eight pleurites bear spiracles. The eighth, ninth and tenth segments are internal. The eighth tergite, or pygidium (e8) is telescoped within the seventh.

The seventh segment is complete, in that it is composed of tergite (e7), tergo-pleural cuticle (f7) or intersegmental skin, epipleurite I (d7), epipleurite II (c7), hypopleurite (b7), and sternite (a7). Between the seventh and eighth segments, when fully expanded, is a broad intersegmental skin (g8).

The eighth tergite (e8) is normal in appearance, but the pleural zone is purely intersegmental or membranous (f8). The eighth sternite (a8) is a flat shield-like plate, which may in folding stand perpendicular. At the base of the eighth sternite is attached internally a long, chitinous rod or apodeme which braces the genital canal and is attached thereto. This apodeme is very similar to the spicule of the ninth sternite in the males. It has been called the kloakstiel by Stein, and may therefore be designated by us as the Cloaca stylyus (h). It is formed by the fusion of two pieces and is probably the fusion of the endo-apophyses mentioned by Böving for Dytiscidae.

In an excellently dilated specimen from New Orleans (figs. 1-3), there was a very definite sternal piece beyond the eighth, which I shall call the ninth sternite. It had a hypopleural piece (b9) attached on each side, and a definite line seemed to separate off a segment with its posterior boundary at the anal valve (j). Dorsally there was no chitinization behind the eighth tergite and before the anal opening (u), but the anterior lip (i) of this orifice was inflated. This anterior lip (i) at least is unquestionably the ninth tergite. The tergo-pleural cuticle is marked with a few flecks of chitin (j) and may possibly thus indicate the cloaca valves described by Böving.

In a single specimen (fig. 5) the anal tube was fully protracted and unquestionably two-segmented, the second segment (w) of the tube has the true anal orifice (x) at tip. In other specimens this eversible tube can be seen within.

The zone beyond the base of this anal tube and the ninth sternite described above, is difficult to interpret.

It consists of an inflated membrane (s) from the anal tube to the vagina or vulva (q), which is an elongate slit bounded by two lateral inflated cheeks (p), at the outer margin of which are palpi (m) with a small terminal joint (n). From the palpi there is a slight chitinization, corresponding to Böving's "Arm". Stein calls the palpi, Vaginal Palpi. Internally the palpi are braced by rods, which may be called the Vaginal Styli. Böving and other authors call that segment bearing the vagina and vaginal palpi, the ninth, placing the palpi and arms as pleurites. If such is the true interpretation, then the sternal plates (a9) are presternum, lobes (o) sternellum, lobes (p) sternum, and the region (r, s) poststernellum.

This makes the first segment of anal tube, the tenth segment, and the second segment the eleventh.

VI. THE GENERA AND SPECIES OF CYLADINAE

TABLE OF GENERA OF CYLADINAE

1. Trochanters of normal size.....2
Trochanters very long, arcuate *Myrmacicetus* Chevrolat
2. Slender, elongate insects with beak cylindrical; posterior femora not as a rule exceeding the tip of the elytra; elytra not inflated *Cylas* Latreille
- Robust insects with short, stout beak; posterior femora surpassing the tips of the elytra; elytra inflated, globular *Protocylas*, new genus

CYLAS Latreille (1802)

1802. *Cylas* Latreille. Hist. Nat. Gen. et Part. Crust. et Ins., vol. 3, p. 196.

1815. *Cylanus* Rafinesque. Anal. Nat. Tabl. Univ., p. 115. New name for *Cylas*. Type, *brunneus* Olivier, monotypic.

1. CYLAS BRUNNEUS (Olivier 1790) Latreille (1802).

1790. *Brentus brunneus* Olivier. Encyc. Meth., vol. 5, p. 190, No. 4.

1802. *Cylas brunneus* (Olivier) Latreille. Hist. Nat. Gen. et Part. Crust. et Ins., vol. 3, p. 196. Type of genus. Senegal.

1842. *Cylas angustatus* (Dejean ms.) Labram and Imhoff. Sing. Gen. Curc., part 1, No. 26. New Synonymy. Senegal.

The description of *brunneus* as given by Olivier is short:

"Corpus brunneum nitidum. Rostrum cylindricum thorace paulo brevius. Oculi nigri ovati vix prominuli. Thoracis partes anterior ovata, postica brevior cylindrica. Elytra ovato-oblonga laevia."

The description of *angustatus* is even briefer:

"Femina: Antennarum clava ovata, obtuse acuminata articulo- rum praecedentium simul sumtorum dimidiam longitudinem aequante."

There were examined two specimens from the Deyrolle collection loaned by the Cambridge Museum, one of which is labelled "*C. angustatus* Dej. Sénégal". This one is headless, but the other is a female. These have the thorax in two distinct parts, the anterior globular, ovate; the posterior shorter, cylindrical. They are brown. Although the description of *angustatus* does not indicate it, the figure shows the thorax is constructed in the same manner as in *brunneus*. I have therefore united the two species.

The female is 6 mm. long, and was illustrated in the 1918 article.

2. *CYLAS FORMICARIUS* (Fabricius 1798) Schönherr (1826). 1798. *Brentus formicarius* Fabricius. Ent. Syst. Suppl., p. 174, No. 5. India.

1826. *Cylas formicarius* (Fabricius) Schönherr. Curc. Disp. Meth., p. 75.

a. Subspecies *elegantulus* (Summers 1875) Pierce (1918).

1875. *Otidoccephalus elegantulus* Summers. New Orleans Home Journal and Rural Southland, vol. 10, No. 3, p. 68, Jan.; No. 26, Dec. 25. Louisiana.

1918. *Cylas formicarius elegantulus* (Summers) Pierce. Jour. Agr. Res., vol. 12, No. 9, pp. 605-607; pl. 31, fig. A; pl. 32, figs. A, B; pl. 33, figs. E-H; pl. 34, figs. A-D.

Studies of this subspecies are embodied in the preceding parts of this article.

3. *CYLAS TURCIPENNIS* (Schönherr) Boheman (1833).

1833. *Cylas turcipennis* Boheman. Schönherr's Gen. et Sp. Curc., vol. 1, pp. 369-370. Java, India. Oriental.

Studies of this species are also embodied in the preceding parts of this article; and in the 1918 article.

4. *CYLAS FEMORALIS* Faust (1898).

1898. *Cylas femoralis* Faust. Deutsche Ent. Zeitschr., vol. 42, p. 24. Kamerun.

This species was very inadequately described.

There were at hand a series of 29 specimens from Mt. Coffee, Liberia, collected in March and April, 1897, by O. F. Cook and R. P. Currie. It attacks sweet potato. Length 4.2 mm.; breadth 1 mm.

Studies of this species are embodied in the preceding sections of this article and in the 1918 article.

5. *CYLAS COMPRESSUS* Hartmann (1899).

1899. *Cylas compressus* Hartmann. Deutsche Ent. Zeitschr., vol. 43, pp. 22, 23. German East Africa, Usambara. Length 5.5-6 mm.; breadth 1.5-1.75 mm.

Two specimens were seen which may belong here. One is labelled "*Cylas brunneus* Fab.? *Cylas metallescens* Linell n. sp. (scratched out)". Tana River, East Africa, Chanler Exped. 92-

93." The other is labelled "At camp, Inhosenque, Dec. 23, 1908. No. 137" from the collection of C. W. Howard. These measure 5.5 and 6 mm. in length.

6. *CYLAS PUNCTICOLLIS* (Schönherr) Boheman (1833).

1833. *Cylas puncticollis* Boheman. Schönherr's Gen. et. Sp. Curc., vol. 1, pp. 372, 373.

This black species from Senegal appears to differ from *C. brunneus* by having the eyes approximate and front canaliculate.

7. *CYLAS LONGICOLLIS* Chevrolat (1830).

1830. *Cylas longicollis* Chevrolat. Guérin's Icon. Regn. Anim., p. 139, vol. 36, fig 10. Senegal.

8. *CYLAS LAEVIGATUS* Fåhraeus (1871).

1871. *Cylas laevigatus* Fåhraeus. Oefv. Vet. Akad. Förh., vol. 28, p. 237. Caffraria. Length 3.5 mm.; breadth 1 mm.

9. *CYLAS RUFESCENS* Fairmaire (1899).

1899. *Cylas rufescens* Fairmaire. Ann. Soc. Ent. France, vol. 68, p. 501. Madagascar. Length 3.5 mm.

10. *CYLAS NIGROCOERULANS* Fairmaire (1902).

1902. *Cylas nigrocoerulans* Fairmaire. Ann. Soc. Ent. France, vol. 71, p. 384. Madagascar. Length 6.5 mm.

PROTOCYLAS, new genus

Type of genus *Cylas laevicollis* Boheman.

This genus is founded for the blunt-nosed species of *Cylas*, which have short, broad beaks, inflated elytra, and femora surpassing the elytra. The facies of the genus is quite distinct from that of *Cylas*.

It is a little difficult to absolutely assign all of the species to one of these two genera, but I have made the following assignments to this genus, after personally examining specimens of six species, which form a definite generic concept.

1. *PROTOCYLAS LAEVICOLLIS* ((Schönherr) Boheman 1833)
n. comb.

1833. *Cylas laevicollis* Boheman. Schönherr's Gen. et Sp. Curc., vol. 1, p. 372. Java.

One female was examined from Depok, Java, collected by Bryant and Palmer, July 22, 1909. Length 5.5 mm.

♀. Black, with greenish metallic lustre on elytra, and purplish hue to thorax. Beak broad, hardly as long as head. Eyes not prominently convex, separated by only about one-third the breadth of the beak. Between the eyes the front is depressed with raised supraocular ridges, and median carina. The sides of the beak in front of the eyes are impressed, and between the eyes the scrobes are pitted. Scrobes at middle of the short beak. The thorax is considerably narrowed behind, but not as deeply constricted as in some species. The elytra are semi-globular when viewed from the sides, but the sides are subparallel from the rectangular humeri.

For comparison with other species, the following micrometer measurements were made as in the preceding tables (17 spaces = 1 mm.).

Length 98 spaces; breadth 33; height 38.
Length of beak 12; breadth 10; height 10.
Length of head 15; breadth 15; height 16.
Length of prothorax 26, to constriction 18, behind it 8; breadth of anterior portion 20, posterior 13.5; height of anterior portion 19; posterior 14; height at constriction 13.
Length of elytra 48; breadth 33; height including abdomen 28. From anterior edge of hind legs to tip of abdomen 28; length of posterior femora 40.
Length of antennal scape 5; funicle 14; club 11.

2. *PROTOCYLAS SUBMETALLICUS* (Desbrochers des Loges 1890) new comb.

1890. *Cylas submetallicus* Desbrochers des Loges. Jour. Asiat. Soc. Bengal, p. 214. Sikkin.

1891. *Cylas submetallicus* (Desbrochers) Faust. Stett. Ent. Zeit., vol. 52, p. 282. Nagpore.

I have seen one female from the Deyrolle collection labelled "India or." This species is very close to *impunctatus*, but the differences can best be brought out by the following measurements on the same scale (17 spaces = 1 mm.)

Length 100 spaces; breadth 36; height 38.
Length of beak 12; breadth 11; height 11.
Length of head 15; breadth 16; height 16.
Length of prothorax 27; to constriction 19, behind it 8; breadth of anterior portion 19, posterior 13; height of anterior portion 17, posterior 13; height at constriction 12.
Length of elytra 52; breadth 36; height including abdomen 30. From anterior edge of hind legs to tip of abdomen 30; length of posterior femora 34.
Length of antennal scape 4; funicle 11; club 10.

3. *PROTOCYLAS IMPUNCTATUS* (Faust 1891) new comb.

1891. *Cylas impunctatus* Faust. Stett. Ent. Zeit., vol. 52, p. 282. Nagpore India. Length 3.5 mm.; breadth 1.2 mm.

One specimen was examined from India, collected by C. V. Piper in 1911. Measures 4.5 mm.

♂. Black, with violet lustre; legs and antennae reddish. Beak broad, not as long as head. Eyes not prominently convex, separated by one-third the breadth of the beak. Between the eyes the front is depressed with raised supraocular ridges, and median carina. The sides of beak between eye and scrobe are longitudinally impressed. Scrobes at middle of short beak. The thorax is very shallowly constricted behind. The elytra are more elongate, less globular.

Comparative measures in micrometer spaces (17 = 1 mm.).
Length 86 spaces; breadth 25; height 32.
Length of beak 10; breadth 8; height 9.
Length of head 14; breadth 14; height 14.
Length of prothorax 22; to constriction 15; behind it 7; breadth of anterior portion 17, posterior 11; height of anterior portion 16, posterior 12; height at constriction 11.7.
Length of elytra 42; breadth 25; height including abdomen 26.
Length from anterior edge of hind legs to tip of abdomen 25; length of posterior femora 31.
Length of antennal scape 4; funicle 10; club 14.

4. *PROTOCYLAS CURTIPENNIS* (Fairmaire 1887) new comb.
1887. *Cylas curtipennis* Fairmaire, Ann. Soc. Ent. France, ser. 6, vol. 7, p. 322. Zanzibar.

A female from the Deyrolle collection (Cambridge Museum) which has been determined as *senegalensis* Gory, *angustatus* Dejean and *cyanescens* Sch. may be assigned here. It measures 4 mm., and is from Senegalia. Another female is labelled "322", and measures the same.

♀. Black (too much covered with dust to determine lustre). Beak broad, not as long as head. Eyes not surpassing margin of head, very faintly convex, separated by about one-third breadth of beak. Front and beak sulcate. Sides of beak with three longitudinal depressions from eye to scrobe. Scrobes at middle of short beak. The thorax is considerably narrowed behind, but not very deeply constricted. Elytra semiglobular, when viewed from side, but with sides almost straight from humeri.

Comparative measurements in micrometer spaces (17 spaces = 1 mm.).
Length 83 spaces; breadth 30.5; height 34.
Length of beak 10; breadth 9; height 9.
Length of head 12; breadth 13; height 14.
Length of prothorax 22; to constriction 15, behind it 7; breadth of anterior portion 16; posterior 12; height of anterior portion 15.5, posterior 12; height at constriction 11.
Length of elytra 44; breadth 30.5; height 24.
From anterior edge of hind legs to tip of abdomen 28; length of posterior femora 31.
Length of antennal scape 4; funicle 12; club 7.5.

5. *PROTOCYLAS CYANESCENS* ((Dejean) Boheman 1833) new comb.
1833. *Cylas cyanescens* (Dejean) Boheman, Schönherr's Gen. et Sp. Curc., vol. 1, p. 371. Senegalia.

One male specimen from the Deyrolle collection (Cambridge Mus.) labelled "460. *Cylas cyanescens* Sch. Guinee, Bocandi." Length 6.5 mm.

A broken female from this collection labelled "*Cylas major* Gory. Senegal. 321", is apparently the same species, but measures 8 mm.

C. cyanescense is described as twice as large as *laevicollis*, and this latter specimen would therefore appear to be more typical.

♂. Black. Beak broad, as long as head. Eyes lightly convex, separated by half the breadth of the beak. Front broadly depressed, with supraocular ridges. Beak sharply sulcate opposite scrobes. Sides of beak depressed in longitudinal lines from eyes part way to scrobes. Scrobes at middle of short beak. Thorax not deeply constricted behind. Elytra more elongate, less globular.

Comparative measurements in micrometer spaces (17 spaces = 1 mm.).

Length 114 spaces; breadth 33; height 40.

Length of beak 15; breadth 10; height 11.

Length of head 15.5; breadth 16; height 16.

Length of prothorax 27, to constriction 19, behind it 8; breadth of anterior portion 20, posterior 14.5; height of anterior portion 20, posterior 17.

Length of elytra 58; breadth 33; height 30.

From anterior edge of hind legs to tip of abdomen 32; length of posterior femora 39.

Length of antennal scape 6; funicle 11; club 20.

6. *PROTOCYLAS SEMIPUNCTATUS* (Fåhræus 1871).

1871. *Cylas semipunctatus* Fåhræus. Oefv. Vet. Akad. Förh., vol. 28, p. 237. Caffraria. Length 7.5 mm.; breadth 2.2 mm.

One specimen in Deyrolle collection (Cambridge Museum) from Cape of Good Hope. Sex unknown.

Black. Beak short and broad, coarsely punctured. Eyes broadly separated, small and barely surpassing margin of head; front and beak to insertion of antennae deeply, medianly sulcate. Head very finely punctate. Thorax finely punctate, anterior portion globular, constriction very sharp, posterior portion convex. Elytra very large, globular, sides rounded; surface almost impunctate, but with very shallow, minute punctures in rows on sides.

Length 7.5 mm.; breadth 3 mm.; height 3 mm.

Comparative measurements in micrometer spaces (17 = 1 mm.).

Length 142 spaces; breadth 53; height 65.

Length of beak 17; breadth 16; height 15.

Length of head 20; breadth 24; height 24.

Length of prothorax 37, to constriction 23, behind it 14; breadth of anterior portion 29, posterior 21; height of anterior portion 25, posterior 22; height at constriction 21.

Length of elytra 68; breadth 53; height 47.

From anterior edge of hind legs to tip of abdomen 32; length of posterior femora 52.

Length of scape 7; funicle ?; club ?

7. *PROTOCYLAS GLABRICENNIS* (Hartmann 1897) new comb.

1897. *Cylas glabripennis* Hartmann. Vien. Ent. Zeit., vol. 16, p. 282. German Africa, Tanga. Length 4.5 mm.; breadth 1.5 mm. Head equal to beak in length.

8. *PROTOCYLAS ROBUSTUS* (Faust 1894) new comb.

1894. *Cylas robustus* Faust. Stett. Ent. Zeit., vol. 55, p. 149. Erytra. Length 5 mm.; breadth 2 mm.

9. *PROTOCYLAS RUFIPES* (Faust 1893) new comb.

1893. *Cylas rufipes* Faust. Ann. Soc. Ent. France, vol. 61, pp. 513, 514. Cochin China. Length 3.3-4.6 mm.; breadth 1.2-1.5 mm.



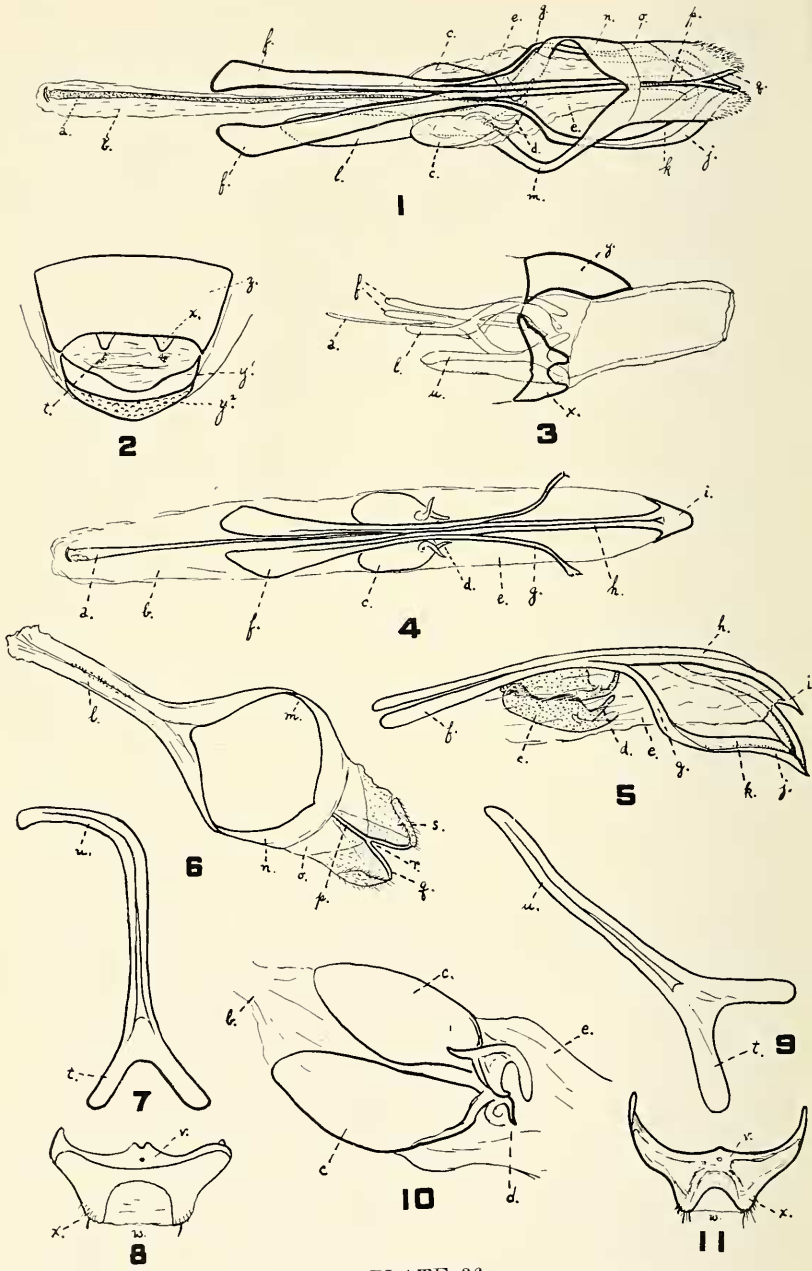


PLATE 36

ILLUSTRATIONS

(All drawings by the author.)

Plate 36—Male genitalia of *Cylas formicarius elegantulus* (Summers) (figs. 1-9), and *C. turcipennis* Boheman (figs. 10, 11).

Fig. 1—Dorsal view of entire genital apparatus of *C. f. elegantulus* from a Daytona, Florida, specimen.

Fig. 2—View of opening of anus, showing tips of eighth sternite, and shadows of ninth sternite (this and figs. 3-9 from New Orleans specimens).

Fig. 3—View of eighth segment from side, with genital tube partly everted, the everted portion being the eighth intersegmental skin.

Fig. 4—Dorsal view of internal sac and epiphallus; periphallus broken off.

Fig. 5—Side view of oedeagus and the internal sac.

Fig. 6—Ventral view of tenth segment, showing posttegumen, ring and strut.

Fig. 7—Spicule, or ninth sternite, showing extreme curvature found.

Fig. 8—Ventral view of eighth sternite of same specimen as fig. 7.

Fig. 9—Spicule, or ninth sternite, of another specimen.

Fig. 10—*Cylas turcipennis* (Buitenzorg, Java) endophallus with its valvae in eurazygos.

Fig. 11—Dorsal view of eighth sternite in *turcipennis*.

EXPLANATION OF LETTERS IN PLATE 36

- a. Flagellum in ductus ejaculatorius.
- b. Stenazygos, anterior portion of ductus ejaculatorius.
- c. Endophallus.
- d. Valves of endophallus.
- e. Eurazygos, widened posterior portion of ductus ejaculatorius.
- f. Struts of oedeagus, or epipleurites (segment 11).
- g. Basal portion of periphallus (hypopleurite) (segment 11).
- h. Epiphallus, or tergite of segment 11.
- i. Verga, containing genital pore, tip of epiphallus (segment 11).
- j. Periphallus, hypopleurite of segment 11.
- k. Hypophallus or sternite 11.
- l. Strut of sternite 10.
- m. Ring portion, pleurites of segment 10.
- n. Basal portion of posttegumen, of tergite 10.
- o. Median portion of posttegumen, of tergite 10.
- p. Base of uncus, tergite 10.
- q. Rods of uncus, tergite 10.
- s. Lobes of tergite 10, cerci, or socii.
- t. Forks of spicule, sternite 9.
- u. Rod of spicule, sternite 9.
- v. Base of sternite 8.
- w. Emargination of sternite 8.
- x. Lobes of sternite 8.
- y. Tergite 8; y^1 inverted portion, y^2 exposed portion.
- z. Sternite 7.

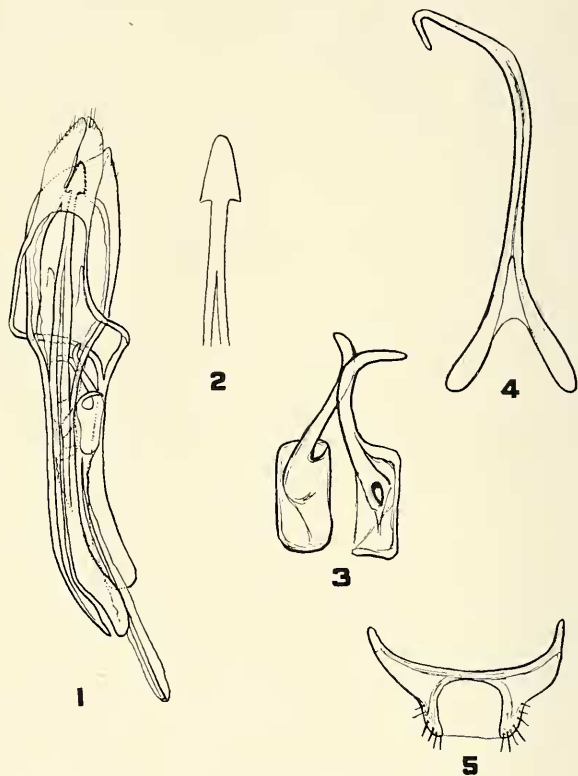


PLATE 37

Plate 37—Male genitalia of *Cylas femoralis* Faust from Mt. Coffee, Liberia.

Fig. 1—Dorsal view of entire genital apparatus.

Fig. 2—Verga.

Fig. 3—Endophallus.

Fig. 4—Ninth spicule.

Fig. 5—Eighth sternite.

Plate 38—Female genitalia of *Cylas formicarius elegantulus*.

Fig. 1—Lateral view of last segments of inflated abdomen, from New Orleans.

Fig. 2—Terminal view of uro-genital area of same specimen.

Fig. 3—Left antero-ventral view of same specimen.

Fig. 4—Left lateral view of last segments of partially inflated abdomen of a specimen from Victoria, Texas.

Fig. 5—Lateral view of a specimen with anal tube exerted, from Victoria.

Fig. 6—Dorso-lateral view of inflated abdomen of Victoria specimen.

Fig. 7—Antero-ventral view of same specimen as figs. 1, 2, 3.

EXPLANATION OF LETTERS ON PLATE 38

- a5, a6, a7, a8, a9. Sternite of segments 5 to 9.
- a9. Vulvar sclerites.
- b. Hypopleurites of segments 5 to 9.
- c. Epipleurites II of segments 5 to 9.
- d7. Epipleurite I of segment 7.
- e. Tergites of segments 7, 8.
- g. Intersegmental skin of segment 8.
- h. Cloaca stylus.
- i. Anterior lip of anal orifice or tergite 9.
- j. Flecks of chitin, which may correspond to cloacal valve.
- k. Vaginal stylus.
- l. Arm of vaginal stylus.
- m. Vaginal palpus.
- n. Terminal joint of vaginal palpus.
- o. Lower lip of vulva.
- p. Lateral cheeks of vulva.
- q. Vulva, or genital orifice.
- r. Upper lip of vulva.
- s. Tergo-pleural cuticle of vulvar segment.
- t. Base of vulvar segment.
- u. Opening for extrusion of anal tube.
- v. Basal segment (tenth) of anal segment extruded.
- w. Apical segment (eleventh) of anal tube extruded.
- x. Anus, or anal orifice.

